Defining Traffic Analysis Zones

Traffic analysis zones (TAZs) are the basic geographic unit for inventorying demographic data and land use within a study area. While the total number of TAZs dictates the size of trip matrices, the size and shape of TAZs can influence model results. Most notably, highway and transit trip loadings and the percent of intra-zonal trips are directly impacted by study area zonal detail and the size of the zones. Consequently, defining an appropriate zonal geography has long been a challenge to the travel demand model community.

Historically, the number of zones in a study area was limited by the capacity and processing power of computers. With the advent of geographic information system (GIS) integrated software and increased micro-computer power and capacity, the maximum number of zones in a study area is much less restricted. Generally, the more zones a study area has, the more useful the model may be for various planning related purposes (e.g. transit modeling, different land use alternatives, studying non-motorized activities, sub-area analysis). Increasing the number of zones in a study area does require additional investment of time and resources. As one contributor noted, "the greater level of zone detail should be balanced with the extra costs associated with the development of detailed input data, model development and maintenance, increased file storage space requirements and increased model run times." Ultimately, the number of zones in a study area is determined by the study area's size and planning needs. The following is a brief synopsis of the contributions to the email list regarding general guidelines for defining TAZs.

Defining TAZs

Generally, the number of zones should not simply be a function of the study area population. There are several factors that contribute to the determination of the number of zones in a travel model, including network detail, potential future alternatives to the network and land use, data requirements of the model (e.g. auto vs. non-motorized travel), and the anticipated growth in the study area. Contributors to the email list offered the following suggestions for determining an appropriate number of zones:

- The number of zones in a study area is typically a function of network geography,
- The number of zones in a study area generally increases as an urban area becomes denser,
- Zones tend to be smaller in denser areas (e.g. CBDs) and larger in areas of low density (e.g. rural areas),
- Larger zones tend to yield a higher percentage of intra-zonal trips.

Contributors also offered several observations regarding zonal structure:

- Where feasible, nesting census geographies (e.g. census blocks) within TAZ boundaries can improve the base year demographic inventory process,
- Additional zones may be required to study the impacts of non-traditional land development patterns, such as neo-traditional developments that encourage non-motorized activities and increase transit access,
- Zones with homogeneous land development can improve traffic assignment loadings to adjacent network,
- Additional zones may increase forecast accuracy and may also improve the modeling of non-motorized trips (e.g. walk and bicycle trips),
- A more refined zone structure improves compatibility for conducting micro-simulations and intersection analyses.

Based on the guidelines and observations noted above, zones are typically defined to be compatible with:

- Study scope and purpose(s),
- Land use homogeneity,
- Adjacent network geography,
- Other geographic features, such as rivers, lakes or railroads, and
- Census geographies.

TAZ Reasonableness Checks

Average zone sizes and ratios of zones per square mile provide useful insights about zone geography coarseness and may highlight potential trip assignment issues. Likewise, the average number of people per zone in a study area is a general indicator of regional density. A number of contributors noted additional metrics and statistics to assess network and land use compatibility with zone geographies. These included:

- Average TAZ size (expressed in square miles),
- Number of TAZs per square mile,
- Average population per zone,
- Number of network links per zone,
- Number of transit links/access nodes per zone,
- Number of zones by sub-area geography (e.g. rural vs. downtown, local-transit vs. all others),
- Trip densities per zone (a threshold value of trips per zone).

The density or size of zones can vary greatly depending on the amount of rural or less-developed areas in a study area. In addition, air quality requirements may require the study area to model outlying regions forcing the inclusion of more remote or developing areas, thereby influencing density ratios.

As one participant to the TAZ discussion noted, statistics regarding TAZ composition and size from a national survey sponsored by the Transportation Research Board (TRB) regarding travel demand model practices are available in the report entitled, "Determination of the State of the Practice in Metropolitan Area Travel Forecasting – Findings of the Surveys of Metropolitan Planning Organizations (Final Draft – June 2007)." The material is available at the following location: http://onlinepubs.trb.org/onlinepubs/reports/VHB-2007-Final.pdf on pages 22 and 23. The material is presented for small, medium and large size Metropolitan Planning Organizations.

Alternative Approach

Different zone structures for different steps of the model could be applied to make the number of zones more compatible with the particular travel model step. As one contributor added to the discussion, "transit and traffic assignments require more spatial detail than trip generation and trip distribution". For example, mode choice and traffic assignment models could have more zones than the prior trip generation or distribution steps, which may not need the same level of detail. Concerns regarding consistency and forecasting accuracy however, lead others to suggest that the best approach is to have the same number of zones for each model step.

Conclusions

A standard for determining if a study area has an adequate number of zones does not exist. While increased computer power has essentially eliminated restrictions on the number of zones for all but the largest study areas, increasing the number of zones does lead to increased data

collection and maintenance costs. Greater zonal detail can improve transit and trip assignment results and extends the potential usefulness of the model for other planning applications and studies (e.g. migrating data to a micro-simulation package). Smaller zones, as some contributors noted, may also discourage the practice of simply implementing special centroid connector capacities or volume delay equations in order to improve the adjacent network loadings.